1. Application Cover Sheet (Attachment A Form)

Public Service Commission of Wisconsin
Office of Energy Innovation
Critical Infrastructure Microgrid and Community Resilience Center Pilot Grant Program

ATTACHMENT A - COVER SHEET

SECTION I - Provide information summarizing the project proposal.		
Project Title:	Resilience Planning for Wisconsin Affordable Housing – Villa West	
PSC Grant Request ($):	**Applicant Cost Share ($):**	**Project Total ($):**
$47,430	$26,080	$73,510
Choose one Eligible Activity		
☐ Critical Infrastructure Microgrid Feasibility Study Level 1 and 2	☐ Critical Infrastructure Microgrid Feasibility Study Level 3	✓ Community Resilience Center Feasibility Study

SECTION II - Provide information for your organization, signatory, and primary contact for the project.				
Applicant Type:	☐ City	☐ Village	☐ Town	☐ County
☐ Tribal Nation		☐ Wisconsin Technical College System		
☐ University of Wisconsin System		☐ K-12 School District	✓ 501(c)(3) nonprofit	
☐ Municipal Utility (water, wastewater, electric, naturalgas)			☐ Hospital (public or nonprofit)	

Name (on W-9):	Wisconsin Housing Preservation Corp (WHPC)
Address (on W-9):	150 East Gilman Street; Suite 1500, Madison, WI 53703
County or Counties Served by Project:	Brown
DUNS Number or CAGE Code:	927097055
NAICS Code:	236116

Authorized Representative/Signatory (Person authorized to submit applications and sign contracts)		**Primary Contact** (if different from Authorized Representative)	
Name:	Rob Dicke	**Name:**	
Title:	Assistant Vice President Asset Management	**Title:**	
Phone:	608-807-1790	**Phone:**	
E-mail:	rdicke@whpccorp.org	**E-mail:**	
Signature of the Authorized Representative			

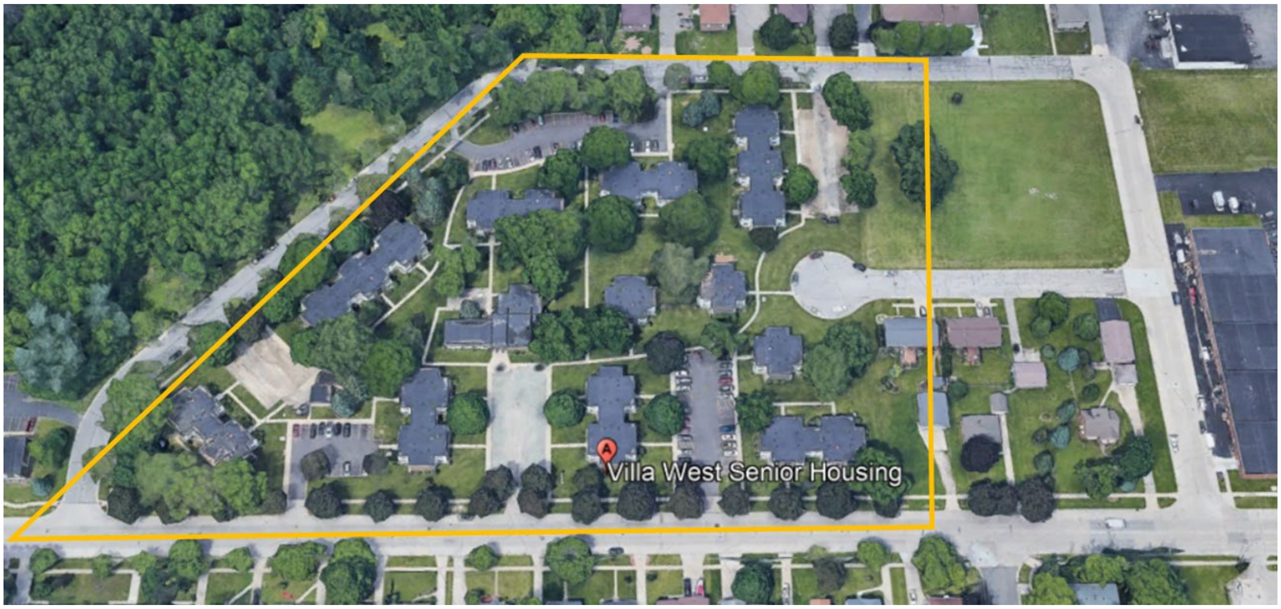
2. Application Budget Sheet (Attachment B Form)

Wisconsin Housing Preservation Corp
Resilience Planning for Wisconsin Affordable Housing

Summary of Project Budget				
Line	**Description**	**PSC Grant Request**	**Applicant Cost Share**	**Total Project Cost**
1	Personnel	$5,000	$7,515	$12,515
2	Fringe		$1,750	$1,750
5	Travel		$735	$735
6	Contractual	$42,430	$16,080	$58,510
7	Other			$0
8	Indirect			$0
	Totals	$47,430	$26,080	$73,510
	% of Total	**65%**	**35%**	-

Applicant Comments: Enter budget information into the gray fields of the Summary Project Budget. Fields are formatted to display whole numbers. This document is formatted to print on 8.5"x11" paper. Include it as directed in your PDF application. Definitions of each line item are provided on the Definitions Tab. (Use this space to add additional budget information.)

3. Application Narrative



Project Description

Wisconsin Housing Preservation Corp (WHPC) and Elevate, a national nonprofit with offices in Madison, WI, are committed to serving affordable housing. We recognize housing – especially affordable housing - as critical infrastructure, as does the Biden administration[1]. We work every day to preserve and revitalize affordable housing to serve those who need it most. Our proposal seeks to develop an energy resilience plan for a WHPC affordable housing development that serves senior and disabled, low- and moderate-income residents in the City of Green Bay, WI. We propose to complete a feasibility study and preliminary design for a Level 1 microgrid community resilience center for the Villa West Apartments campus. The Level 1 microgrid will incorporate rooftop solar and storage on 12 campus buildings and will support a community resiliency center to serve as a safe haven and emergency heating/cooling resilience hub for residents in the event of a power outage or extreme weather conditions.

This microgrid seeks to provide continuous operation of several critical lifelines in the event of a power outage or extreme weather. These include several key lifeline categories as defined by FEMA's Community Lifeline Tool Kit, including Food, Water, and Shelter for senior and disabled residents; Energy, by managing power supply and grid maintenance for this 170-unit affordable housing campus; with the potential for supporting Health and Medical lifelines by providing drug and medical supply storage for residents. These lifeline categories are critical to health and wellbeing of the Villa West residents in the event of a power outage or extreme weather.

The feasibility and preliminary engineering design for the CRC Level 1 microgrid includes:

1. Property Assessment
2. Benchmarking and Load Analysis

[1] [1] https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/

3. Solar Design
4. Critical Load Assessment
5. Storage and Microgrid Design
6. Optimization and Financial Analysis
7. Recommendations and Reporting
8. Funding and Procurement Support

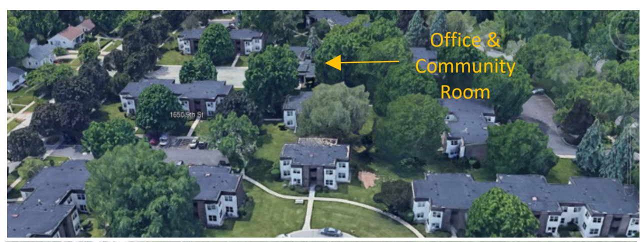
Our proposal seeks grant funding to provide critical pre-development technical capacity and engineering work needed to develop a microgrid design for the Villa West Apartments and to support the subsequent work of funding/financing and procuring the systems needed to make this a reality. We believe this feasibility study and preliminary design will be a blueprint for developing affordable housing resiliency hubs in the region and nationally.

The details below provide comprehensive descriptions of the analytical and design processes involved in microgrid design and shares the rationale and anticipated outcomes. Reference materials have been included in the appendix for primary technologies discussed in this proposal. These materials include:

- REopt Energy Modeling Software
- HOMER Energy Modeling & Microgrid Design Software
- Schneider Electric EcoStruxure Microgrid Operation Controls
- Siemens RTU SICAM Microgrid Operation Controls
- Hitachi e-mesh Microgrid Operation Controls

4. Merit Review Criteria

4.1. Identification of Critical Infrastructure



The Villa West Apartments in Green Bay, Wisconsin provides affordable housing and independent living amenities to low- and moderate-income senior and disabled residents. The coronavirus outbreak has put the U.S. housing crisis and the need for healthy housing in the spotlight, underscoring the fact that our most vulnerable populations, such as the Villa West residents, are often residents in affordable housing and, even though they are renters, rely on their apartments as safe havens in times of crisis as oftentimes they have no other place to go or must rely on medical support to be moved. With over 777,000[2] Wisconsin residents living in rental housing, housing is considered critical infrastructure and serves as a safe haven, providing shelter and access to heating, cooling, and power for critical systems (e.g., medicine and medical devices) for Wisconsin's most vulnerable residents and communities in the event of power outages or interruptions. Another important need for a CRC is the impact of extreme heat. Extreme heat events can

---

[2] National Low-Income Housing Coalition: Out of Reach Report

trigger a variety of heat stress conditions, such as heat stroke or aggravated respiratory conditions. Seniors and the disabled are disproportionately at risk for extreme heat impacts, especially during power interruptions or outages.

This 10-acre Villa West campus has 12 low-rise buildings, with 170 units of affordable housing, as well as an onsite, 1,000 square foot office and community room, with a kitchen, library, and community gathering space. This shared space is used for social events, family functions, and a resident gathering space, and can be used as an emergency heating and cooling center in the event of a power outage. Each individual building (about 12 to 16 units per building on average) is master-metered, and all utilities are paid by WHPC.

The Villa West property is currently undergoing a major rehab. As part of this rehab, WHPC will incorporate energy efficiency measures such as added wall and roof insulation, efficient lighting, and upgraded HVAC equipment to reduce operating costs but also make the units more comfortable for the residents. Completing this feasibility study for a Level 1 microgrid as part of the rehab process will allow WHPC to incorporate the upgraded systems into the microgrid design.

4.2. Key Partners and Stakeholders

The key partners to complete the feasibility study and engineering design include Wisconsin Housing Preservation Corporation, Elevate, American Microgrid Systems, and WPS, the local utility. Key stakeholders are the residents of the Villa West's 170 units community and other affordable housing providers that will benefits from the results of the feasibility work.

The primary applicant for this grant request is Wisconsin Housing Preservation Corp. (WHPC), a 501(c)(3) nonprofit organization and a prominent leader in the affordable housing industry. WHPC believes that housing is a basic right and that it is the first step to building a better life for residents served. As the largest affordable housing provider in Wisconsin, WHPC provides safe and affordable housing to more than 8,355 low- and moderate-income households, serving as a cornerstone for seniors to age in place, families to have a consistent place to call home, children to improve academic performance by attending the same neighborhood school over time, those living with disabilities to maximize their potential, veterans to reintegrate into society, those dealing with alcohol and drug dependency issues to take advantage of onsite AODA services or referrals, and unemployed or underemployed to complete their education and utilize job training programs. WHPC is proud to be on the front line of providing quality, affordable housing throughout Wisconsin and to lead by example with innovative projects that improve the quality of life for WHPC residents. We stand ready to meet the challenge of helping our communities provide low-income housing that is worthy of the word "Home." As the primary applicant and owner of the Villa West property, WHPC will be responsible for overall project management and deliverables.

Feasibility and engineering work will be completed by Elevate and American Microgrid Solutions (AMS). Elevate is a mission-based 501(c)(3) dedicated to smarter energy use for all. Founded in 2000, Elevate works nationally with a team of 150 people located in CA, IL, MI, MO, OR, and WI. Our energy analysts, construction managers, and project managers provide affordable multifamily housing and non-profits with a suite of energy efficiency, water efficiency, and onsite generation services to improve the overall operation and performance of their properties. We offer support throughout the entire upgrade process, beginning with an analysis of current usage, an onsite assessment, project scope development, and integrated design assistance through construction oversight, quality assurance and quality control, green certification administration, and post-upgrade monitoring. To date, Elevate has been responsible for over $73 million worth of energy efficiency upgrades made to over 66,000 residential units saving 9.7 million therms of gas and 34 million kWh of electricity. We have also facilitated the installation of more than 22 MW of solar serving low-income and environmental justice communities. Elevate also works closely with municipalities on climate and energy planning, solar mapping, and street lighting retrofits and with utilities on demand response programs. Lastly, Elevate administers workforce development programs for clean energy industries in several states: www.elevatenp.org.

American Microgrid Solutions will support solar and microgrid design and optimization analysis, particularly where campus wide aggregated analysis is necessary. AMS delivers hybrid power systems and energy tools that improve security, savings, and sustainability for a wide range of facilities. These systems combine solar, battery storage, and conventional generation for the optimal mix of performance, economics, and carbon reduction. AMS works with community-based organizations in low-to-moderate income communities providing technical, financial, and other resources that are often lacking. AMS has designed solar+storage systems in more than a dozen states and the District of Columbia. Their portfolio of multi-family affordable housing projects includes properties in Boston, Buffalo, Washington DC, Minneapolis, and Detroit. The AMS team brings a unique combination of design, engineering, and operating experience. Ricky Buch, solutions specialist, developed microgrid projects in multiple countries for General Electric and serves as a leading microgrid consultant to the World Bank.

Utility Engagement

The electric and gas utility that serves the Villa West Apartments is [Wisconsin Public Service](#) (WPS). The project team has engaged WPS to share details of the proposed planning and scope of project. While WPS policy does not allow for issuing specific letters of support for proposed projects, WPS representatives have ensured us that this type of project would be allowed and feasible on their grid, and that WPS will work with the project team to assess feasibility and interconnection requirements.

Villa West Apartments Resident Engagement

While the Villa West Residents community does not have a formal resident group, WHPC and our partners will develop a communication strategy to engage residents in a way that includes their ideas and priorities in our scope development and planning. This will include a combination of resident surveys and interviews. We will ensure that our methodologies are flexible and easy for all residents to participate, including paper surveys, phone surveys, and electronic surveys.

Of particular importance for this project will be gathering resident feedback on determining priorities for the critical load. This will include resident power usage during an outage. For example, is heating and cooling a common area a priority, common campus lighting, the ability to charge computers and phones, or the ability to store medicine or medical supplies. These priorities will be integrated into the critical load design and, ultimately, into the generations and storage requirements for the final microgrid design. It is likely that several scenarios will be designed to allow analysis that balances resident priorities, financial performance, and general feasibility.

4.3. Project Resilience Objectives and Metrics

The aim of our effort is to develop a feasibility study, including preliminary engineering design, for a CRC Level 1 Microgrid for Villa West Apartments that currently serve as critical infrastructure for residents. The feasibility study will include the following project objectives: 1) introducing onsite solar generation behind the meter for all 12 Villa West buildings thereby reducing reliance on fossil fuel and lowering energy costs; 2) introducing energy storage and islanding technology that can isolate critical loads in the event of a power outage and provide heating and cooling during extreme weather events; and, 3) providing education resources and engagement to ensure residents are a meaningful part of the planning process. Several key metrics will be used to guide the design process including:

Objectives and KPIs:

On-site solar	Energy Storage and Islanding	Education and Engagement	Financial Performance
Rooftop solar systems that reduce electric load by at least 50%	Energy storage and islanding technology that provides 100% of energy for the identified critical load for at least 24 hours.	In-unit plug load reduction measures using Focus on Energy kits coupled with education; preparedness planning; etc. for Villa West residents	Lifetime solar, storage, and microgrid investment scenario with an Internal Rate of Return of at least 5%.
Reduction in electric utility bills and operating costs.		Resident engagement on critical loads	A positive Net Present Value and payback before end of system life.
		Case study	

It should be noted that energy efficiency measures and associated savings will be incorporated into the planned rehab of the Villa West property and will therefore be considered as part of the load analysis.

An overarching objective of the feasibility study will be to optimize onsite generation and storage capacity in a way that balances the amenities served by the critical load, the duration those amenities are available during an outage, and the financial performance of the systems over time. The importance of financial performance is critical to sustaining this important development therefore we will include financial performance indicators such as Internal Rates of Return, Return on Investment, Net Present Value for various implementation options.

4.4. Evaluation of Site-specific information

The Villa West Apartments campus comprises 12 buildings with 170 one-bedroom units that average 500 square feet per unit. The campus also includes a resident management office with a kitchen, activity center, and club house within a common community room and in a park-like setting. Similar building envelopes across the campus will also simplify the onsite generation system design for each building.

The property campus is made up of 12 buildings, each individually master-metered; as such residents do not pay electricity bills. Master-metering offers flexibility in energy storage and microgrid planning to allow for maximizing behind the meter solar generation on each building rooftop and meter, with micro-islanding (discrete at the individual building level) or macro-islanding (a single, campus wide system) potential. Our planning will allow us to design optimized energy systems, post-energy efficiency, and determine whether islanding each individual building through smaller inverters and relays or the entire campus using an aggregated campus load and master microgrid technology provides greater flexibility, security, and financial performance. The following will be included in the feasibility study:

Task	Description	Lead Org
1. Property Assessment	Assess roofing and electrical, shading and orientation, structural, metering and grid connectivity. Review planned energy efficiency work.	Elevate
2. Benchmarking and Load Analysis	Analyze 12 to 24 months of energy usage, tariffs, rates, and metering; Acquire and analyze load data for individual buildings and aggregate for campus wide load; Project energy efficiency impact to load profile(s), model load data where needed. Establish a post-efficiency campus load model and interval dataset for Solar and Storage analysis.	Elevate/WHPC
3. Solar Design	Design optimal solar generation on each building rooftop; Consider orientation, shading, roofing, and interconnection; Maximize load offset with individually metered and single campus system design options.	Elevate
4. Critical Load Assessment	Engage WHPC, residents, and other stakeholders to determine the agreed upon criteria for critical; Establish the critical load capacity and duration benchmark based on criteria; Optimize solar and storage to balance offset, costs, and critical load criteria; Incorporate load management/peak shaving, and potential ancillary services to maximize financial performance where possible and realistic.	WHPC/Elevate
5. Storage and Microgrid Design	Model multiple scenarios of solar/storage/microgrid as needed to measure energy goals and financial returns	Elevate/AMS
6. Optimization and Financial Analysis	Analyze individual building storage (relays/cutoffs/loads) and a compare to campus wide load/system; Optimize designs for best meeting established criteria and meeting financial goals (see metrics)	Elevate/AMS
7. Recommendations and Reporting	Prepare a final report of all analyses, inputs, scenarios, and anticipated financial performance outcomes; Make final recommendations; prepare system and component designs for each scenario, including equipment lists, cut-sheets, one line drawings, performance data and summaries, financial projections.	Elevate

Task	Description	Lead Org
8. Funding and Procurement Support	Provide guidance on sources of incentives, grant funding, and financing; Support submission of funding/financing applications and proposals; Support procurement efforts, once funding is secured, including RFP development and proposal review.	WHPC/Elevate

4.5. Technologies under consideration

A microgrid can be defined as an integration platform of distributed energy resources, energy storage devices, and flexible load, which are connected in a low voltage distribution network. Those resources are managed by a control system to guarantee the energy supply for users according to defined criteria, which can be financial, environmental, technical or a combination of all of these. The feasibility study allows for the evaluation of different equipment and technology types that measures outcomes in a way that balances these goals. As such, the final technology types and equipment lists will be detailed at the end of that design process. However, some technology considerations can be made based on current site configuration.

Type	Rationale
Energy Efficiency	Energy efficiency planning is currently underway and will include lighting, upgraded air conditioning, and weatherization in each unit and building space. Lighting upgrades will convert incandescent lighting to LED throughout the campus. Old, inefficient air conditioners will be replaced with efficient, Energy Star™ rated units. The energy efficiency plan will be implemented as part of WPHC's current capital planning and will ensure the campus is fully solar-ready at the completion of the proposed analysis.
Solar Panels	Solar arrays are most likely to include monocrystalline silicon solar panels. These are the most common and widely available panel types in the U.S. and offer a wide range of efficiency, configuration, and cost options.
Inverters	Inverters will likely need to be grid-interactive, smart inverters. The use of micro inverters or string inverters will be determined during the optimization process and dependent on whether all arrays are aggregated into a single AC load or each building is a discrete system.
Battery Storage	Similarly, lithium-ion battery batteries are highly efficient and widely available, so will likely be considered in this model. All battery types can be included in the optimization process with HOMER Grid or REopt. The final capacity needs and microgrid controllers will influence this decision, as well.
Microgrid Controls	The microgrid controls are anticipated to be simple, in that the aim is to manage loads and smoothly dispatch between in-grid and islanded modes. The controllers may be optimized to manage loads (peak shaving). But it is unlikely that any other ancillary services will be viable in this situation or market. The most common controllers in this category include the Schneider EcoStruxure, Siemens RTU, or Hitachi e-Mesh, for example.

**Specifications and product sheets for some of the equipment and products detailed above is listed in Section 3 above and attached to this proposal in the Reference Section.*

4.6. Cost Match

The capacity of affordable housing owner/operators is commonly constrained due to tight operating budgets and the need to deliver enhanced, mission-driven services to underserved communities. For highly technical aspects of building improvements, energy management, renewables, storage, etc., this capacity is further constrained because of technical barriers. Therefore, opportunities like the PSC Critical Infrastructure Microgrid & Community Resilience Center Pilot Grant are critical to allow these important segments of the economy to participate. The following cost match will be provided by WHPC and Elevate outside of the grant funding being sought to further the impact of this grant and increase the likelihood of fully implementing the results of the feasibility study.

- WHPC will provide $10,000 in labor and travel expenses
- Elevate will provide match funds of $15,000 to support the CRC Level 1 microgrid feasibility study.

Additionally, WHPC will fully manage and fund the energy efficiency analysis and implementation. They will work with independent contractors to secure energy assessments for the buildings and campus, facilitate the analysis, and ensure robust recommendations are provided, including specific upgrades, equipment lists, costs, etc. WHPC will then implement the recommendations as part of their current capitalization plan. Energy efficiency upgrades and other capital improvements slated for Villa West Apartments are anticipated to cost approximately $800,000. *These activities are not included as part of the cost match in this grant budget but are borne by WHPC as part of the rehab process.*

The results of the CRC Level 1 microgrid feasibility study will provide the funding blueprint for implementing the project. With the deliverables from this process, WHPC will be ready to take advantage of many opportunities for funding including grants and incentives, financing opportunities and company reserves.

4.7. Data Collection Plan

The energy planning process is data intensive. Elevate will lead the data management and analysis process, collecting energy usage data, load data, and occupancy information. Data will be transferred and stored within a secure and encrypted environment. WHPC and Elevate will coordinate with WPS to access utility data for each building which will be the basis for the load modeling calculations and the solar modeling and analysis. Building operation data will be available through WHPC.

Solar array designs will be created by Elevate for each building, with a data output for each array exported and managed separately, then aggregated into campus-wide power generation data. This data, along with interval data, will be imported into HOMER Grid and/or REopt for load modeling, and storage and microgrid design optimization. Each microgrid design iteration will include an output of projected building and/or campus load profiles, as well as financial assessments that will allow for 25-year cashflows and key financial metrics for each scenario. All this data will be stored separately using established naming convention protocols.

4.8. Systems Sizing Analysis

The processes for system sizing and identifying optimal equipment are integrated and fundamentally built around load analysis. That analysis will begin with a detailed load analyses of electricity usage using utility data for the most recent 12-month period. Elevate engineers will analyze each building and unit, common areas, and the office/community room, looking at electricity usage and patterns for each individual building, considering average daily and seasonal usage patterns. These loads will be aggregated and modeled to account for post-energy efficiency performance at the campus level, with similar analysis of usage variations.

Each load and the aggregated campus load will be analyzed to determine the optimal onsite generation and storage capacity using HOMER Grid software and the National Renewable Energy Laboratory's REopt software. This approach allows Elevate engineers to maximize offsetting electricity usage with onsite generation and using stored power to balance the loads at peak usage times. The analysis of battery capacity and islanding technology will also allow for simulated regulation of battery dispatches in a way that ensures efficient load management and the ability to maintain power for critical load dispatch in the event of a power outage. The amount of solar and storage capacity can be adjusted to maximize this efficiency with critical load requirements, while considering overall costs. The final design recommendation will be an optimized balance of these, using an iterative process that analyzes multiple configurations of energy load, solar, storage, and dispatch scenarios.

The process above will be iterated for each building. All of the individual loads will then be aggregated to create a single campus load and the process repeated for this configuration. We will compare the storage needs and functions for managing multiple, discrete critical loads against a campus-wide system and critical load. In the micro-load scenario, the community room and office will require the greatest onsite generation and storage capacity to facilitate the larger critical load. If a significant gap is found in the ability to meet the generation or storage capacity requirements within the discrete design, the discrete approach to the microgrid may need to be abandoned and a campus wide system recommended.

4.9. Financial Analysis (including cost/benefit analysis, financing options)

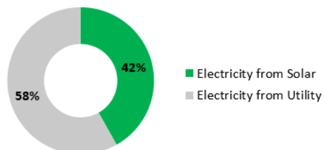
The financial analysis will include all the costs for equipment and installation for each configuration being analyzed, as well as costs for permitting, interconnection, cost of capital, O&M, etc. The value of generated power will be integrated into the cashflow based on tariffs and net metering requirements for the site. Offsets and savings from load management or ancillary services (if analyzed) will be integrated, as will specific and quantifiable financial benefits to tenants. The value of incentives, monetized tax equity, RECs, or other additions to the value stack will be included in the analysis, toggling key value-stack inputs in a sensitivity analysis, as needed for each scenario.

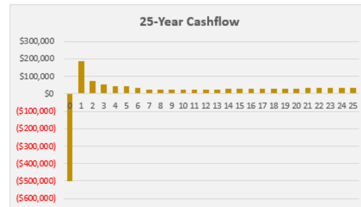
Tenant non-energy, resilience, and environmental benefits are more difficult to quantify in the value stack and methodologies somewhat controversial in the industry. However, these benefits can be captured and measured were possible separately. These can include health and safety, job creation, resilience, education, and reduced emissions, for example.

If no technical limitations exist for the discrete microgrid scenario, each configuration will produce metrics that can be analyzed and compared. As mentioned previously, these include the size of the critical load, the duration of the critical load, and the cost and long-term financial performance of each system. The optimal scenario provides the longest duration of powering the full critical load, where long-term financial performance exceeds financial goals. These financial goals can be a minimum Internal Rate of Return on an outlay or financing of the project (above 5% for example), a minimum Return on Investment (10% for example), a Net Present Value close to $0, or simple payback threshold (not greater than 12 years for example). The images below provide a graphic example of an Elevate standard pro forma summary, as well as a portion of the 25-year cashflow. These are for illustrative purposes only.

Summary Financial Metrics

Key Performace Indicator		
25-Year Costs:	$	($605,631)
25-Year Revenues:	$	$1,079,347
25-Year Net Benefits:	$	$473,717
25-Year Net Present Value (NPV):	$	$237,398
Return on Investment (ROI):	%	78.2%
Internal Rate of Return (IRR)	$	8.9%
Upfront Costs	$	($500,000)
Average Annual Revenue	$	$18,949
Payback Period:	years	8.8





Business Case - System Owner

Year			0	1	2	3	4	5	6	7	8
INSTALLATION COSTS											
Generation Equipment	$	48%	($232,200)								
Balance of Plant	$	24%	($115,268)								
Interconnection	$	6%	($29,330)								
Development Costs & Fee	$	23%	($111,202)								
Site Preparation cost	$/Installed watt	**$0.06**	($12,000)								
Site Purchase Cost	$	**$0**	$0								
Removal Cost	$	**$0**	$0								
Site lease cost (based on per acre $=	$/Acre/Yr	**$0**	$0.00								
Total Installation Costs			**($500,000)**								
CAPITAL COSTS											
Construction loan	$		$0								
Construction loan downpayment	$		$0								
Construction loan closing costs	$		$0								
Construction loan payments	$			$0	$0	$0	$0	$0	$0	$0	$0
Operating loan	$			$0							
Operating loan downpayment	$			$0							
Operating loan closing costs	$			$0							
Operating loan payments	$			$0	$0	$0	$0	$0	$0	$0	$0
Total Cost of Capital			$0	$0	$0	$0	$0	$0	$0	$0	$0
OPERATING EXPENSES		$/kW/Yr									
Fixed O&M Expense	$	$10.40		($2,080)	($2,122)	($2,164)	($2,207)	($2,251)	($2,296)	($2,342)	($2,389)
Insurance	$	$3.40		($680)	($694)	($707)	($722)	($736)	($751)	($766)	($781)
Project Administration	$	$5.20		($1,040)	($1,061)	($1,082)	($1,104)	($1,126)	($1,148)	($1,171)	($1,195)
Total Operating Expense				($3,800)	($3,876)	($3,954)	($4,033)	($4,113)	($4,196)	($4,279)	($4,365)
TAX BENEFITS											
Federal ITC	**26%**	Year 1		$101,087							
Federal MACRS Cash Equivalent	**35%**	$175,000		$62,924	$50,339	$30,203	$18,122	$18,122	$9,061		
Low Income Housing Tax Credit	**No**	4%		$0	$0	$0	$0	$0	$0	$0	$0
New Markets Tax Credit	**No**			$0	$0	$0	$0	$0	$0	$0	
Total Tax Benefits				$164,011	$50,339	$30,203	$18,122	$18,122	$9,061	$0	$0
INCENTIVES											
SRECs	$	Up to 15 years		$0	$0	$0	$0	$0	$0	$0	$0
Incentive #1	$ per installed watt	0%		$0							
Incentive #2	$ lump sum up front	0%		$0							
Incentive #3	[please select]	0%		$0							
Incentive #4	[please select]	0%		$0							
Total Incentive Payments				$0	$0	$0	$0	$0	$0	$0	$0
REVENUES											
Net Metering - Load 1	$	$ Annual		$26,365	$26,758	$27,156	$27,559	$27,968	$28,382	$28,801	$29,225
Net Metering - Load 2	$	$ Annual		$0	$0	$0	$0	$0	$0	$0	$0
Site Lease Payments	$	Fixed Annual		$0	$0	$0	$0	$0	$0	$0	$0
Demand Charge Savings	$	Estimated		$0	$0	$0	$0	$0	$0	$0	$0
Total Revenue				$26,365	$26,758	$27,156	$27,559	$27,968	$28,382	$28,801	$29,225
CASHFLOW											
Net Benefits (Costs)	$		($500,000)	$186,577	$73,221	$53,406	$41,649	$41,977	$33,247	$24,521	$24,860
Cumulative Cashflow	$		($500,000)	($313,423)	($240,202)	($186,796)	($145,147)	($103,171)	($69,923)	($45,402)	($20,541)
Payback Calculation		Years	**8.8**	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Internal Rate of Return											
Internal Net Benefits (Costs less loans)	$		($500,000)	$186,577	$73,221	$53,406	$41,649	$41,977	$33,247	$24,521	$24,860
Internal Cumulative Cashflow	$		($500,000)	($313,423)	($240,202)	($186,796)	($145,147)	($103,171)	($69,923)	($45,402)	($20,541)

Assessing Financing and Implementation Funding Options

Several financing and funding options will be analyzed and compared as part of the financial analysis. This can include incorporating any local incentives, potential grants, as well as commercial or specialized financing. For example,

- Tax equity financing would provide the option for a portion of tax benefits to be added the value stack as part of financing. Tax equity options can lower overall costs and provide both construction and operating loans solutions. Some organizations have simplified the monetization process for nonprofits, like BlocPower, Legacy Solar, and CollectiveSun.
- Commercial financing can be considered based on current market rates. Based on the value of the current project, the commercial cost of capital may provide reasonable returns.
- Regardless of the financing options preferred, grants and incentives will be considered were possible. Grants might include foundation grants focused on resilience, like those from Kresge Foundation or those facilitated by the Clean Energy Group. Other incentives can include Focus on Energy

4.10. Environmental Impact

Environmental benefits will include reduction in kWh from the efficiency measures implemented as part of the rehab and the inclusion of rooftop solar on each building. We will calculate energy savings based on the load analysis and final solar design. The savings analysis will use Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator[3] to calculate reduction in greenhouse gas emissions from the energy savings.

[3] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

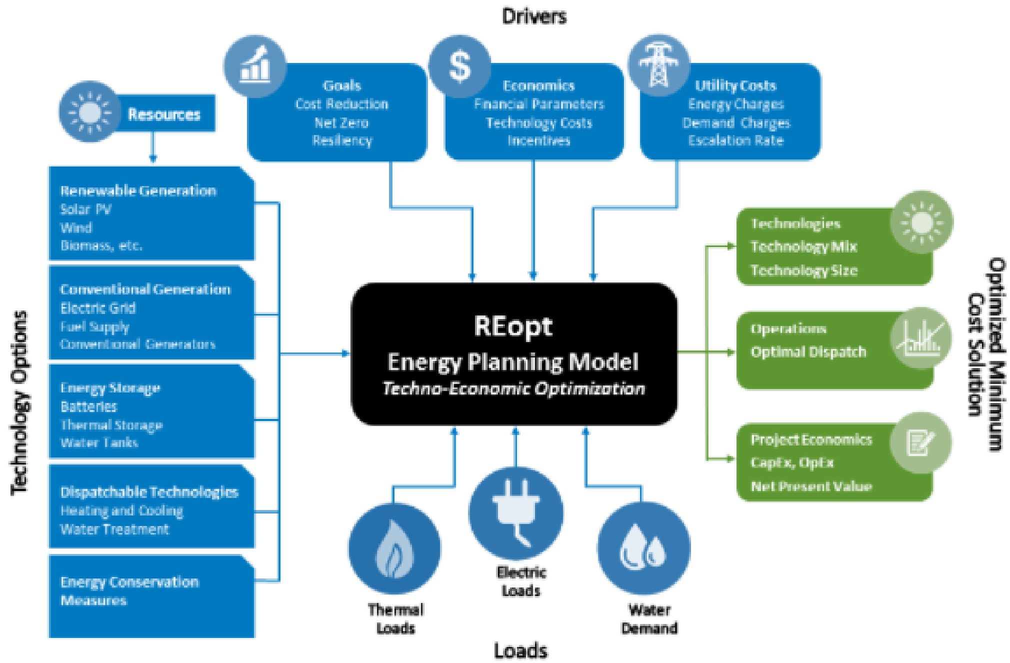
Appendix A: Technical Reference Materials

REopt Energy Modeling Platform

REopt Model Inputs and Outputs

The REopt™ model employs an integrated approach to optimizing the energy costs at a site by considering a range of project inputs and outputs.

The model's inputs include electricity and thermal energy consumption, water demand, resource availability and technology options, and other drivers such as complex tariff structures, incentives, net metering, and interconnection limits. Outputs include optimal energy technologies and system sizes, recommendations for system operations and dispatch, and an assessment of project economics.



A diagram describes REopt's inputs and output, including loads, technology options, drivers, and an optimized minimum cost solution. *Illustration by NREL*

Technologies

REopt models the following energy technologies:

- Solar photovoltaics (PV)
- Solar hot water
- Solar ventilation air preheating
- Wind turbines
- Biomass heating, electricity, and combined heat and power
- Waste-to-energy heating, electricity, and combined heat and power
- Landfill gas heating, electricity, and combined heat and power
- Ground-source heat pumps
- Fuel cells
- Electric storage
- Thermal storage
- Water treatment and storage
- Dispatchable heating and cooling
- Energy conservation measures (via Open Studio)
- Natural gas and diesel generation
- Utility grid.

HOMER Energy Modeling Platform

Robust hybrid microgrid optimization modeling

HOMER® Pro provides insight into the complexities and tradeoffs of designing cost-effective, reliable microgrids or distributed energy resources. HOMER Pro models hybrid systems that combine conventional and renewable energy, storage and load management, driving informed decisions so you can design your systems with confidence.

Optimizing microgrid design

HOMER® Pro microgrid software enables optimization of microgrid applications in all sectors—from village power to islanded utilities. Built on the trusted, standard-setting HOMER software, HOMER Pro combines three powerful tools nested in one software product, enabling engineering and economics to work side by side and provide informative system insights.

Gain insight, manage costs

At its core, HOMER is a simulation model. It simulates, optimizes, and analyzes your electrical system design using resources, load profiles, and components to deliver the least-cost solution and economic risk-mitigation strategies.

HOMER Pro simulates the operation of a hybrid microgrid for an entire year, in time-steps from one minute to one hour. It looks at all possible combinations of equipment and presents options that you can select to create an optimal system. HOMER simulates hundreds or even thousands of systems in a single model run

The software lets you ask as many "What if?" questions as you'd like. If you are uncertain about variables in your model, HOMER Pro's sensitivity analysis feature lets you consider multiple possibilities for almost any variable. You gain insight into "what matters when" before you build, which helps you optimize your system and manage project costs.

Easy and efficient analytics

HOMER Pro makes it easy to compare thousands of possibilities in just a single run, examining all potential combinations of system types and then sorting the systems according to the optimization variable of choice. This allows you to see the impact of variables beyond your control, such as wind speed and fuel costs, and understand how the optimal system changes with these variations.

Simplified optimization

HOMER Pro features our proprietary optimization algorithm that significantly simplifies the design process for identifying least-cost options for microgrids or other distributed generation electrical power systems. HOMER Optimizer™ is a "derivative free" optimization algorithm that was designed specifically to work in HOMER.

Insightful Customer-Facing Proposals

Quickly turn your analysis into a branded proposal that demonstrates cost-savings to your customer. Present key aspects of a proposed system, offer clear cost comparisons, and outline economic value streams. You save time and earn customer trust with a professional proposal.

Customizable design

HOMER Pro can be customized with up to 9 individual modules to meet your specific modeling needs:

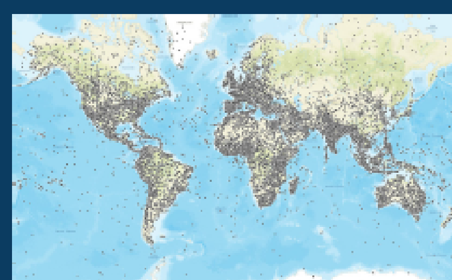
- Biomass
- Hydro
- Combined Heat and Power
- Advanced Load
- Advanced Grid
- Hydrogen
- Advanced Storage
- Multi-Year
- MATLAB Link

Benefits of using HOMER Pro

- Reduce costs of proposal development by determining early stage project feasibility
- Achieve least-cost design by building out the basic design of a microgrid or distributed energy resource (DER) system
- Mitigate project risk by considering all options and scenarios
- Compare competitive components in various simulated environments
- Identify price points at which different technologies become competitive
- Produce insightful customer-facing proposals that demonstrate system value

About HOMER Energy by UL

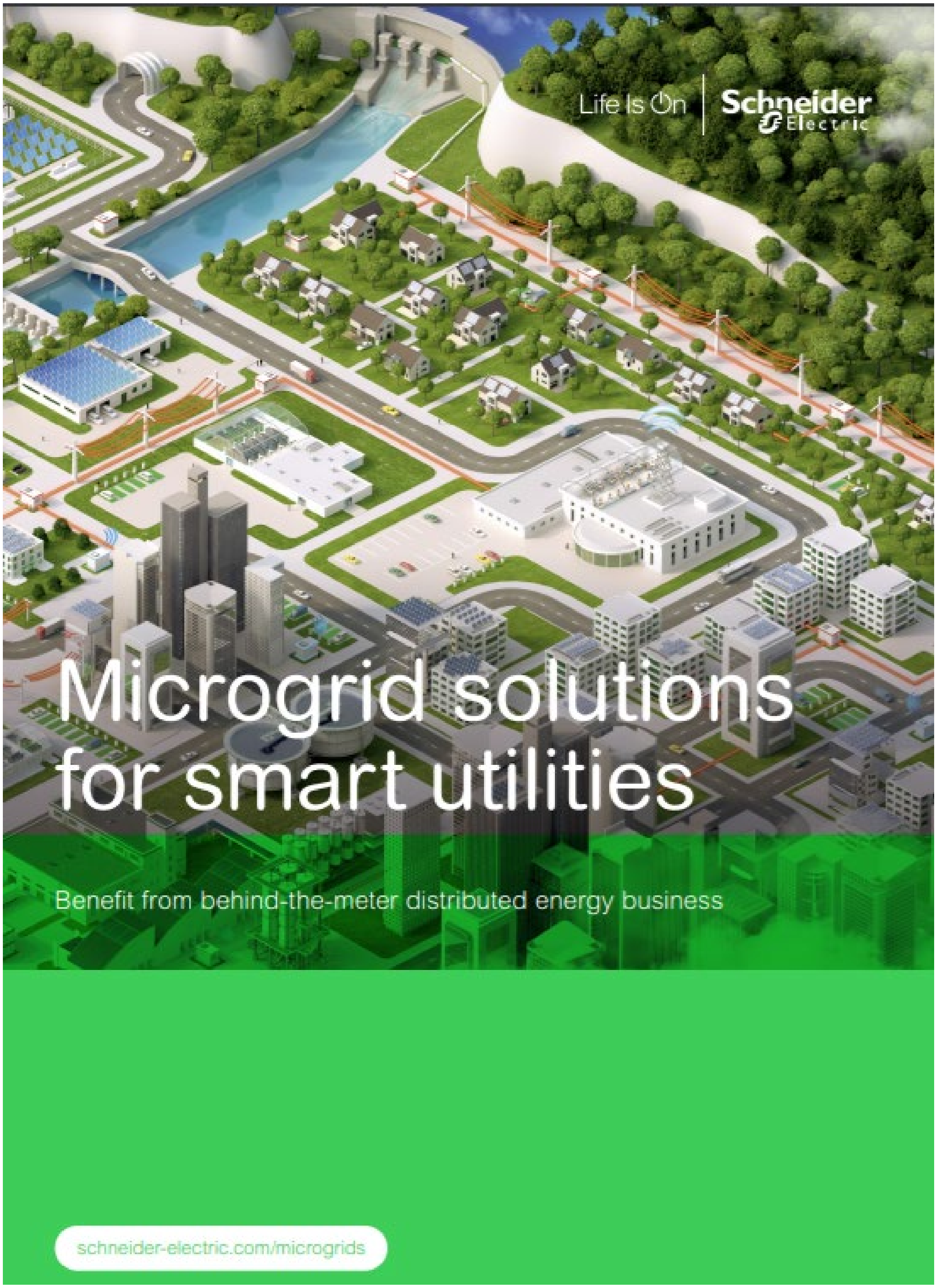
Originally developed at the National Renewable Energy Laboratory, HOMER (Hybrid Optimization Model for Multiple Energy Resources) set the global standard for desision making on the optimal mix of resources, system configuration, and capital and operating costs of microgrids. HOMER software has enabled more than 200,000 users worldwide to produce economic feasibility studies, system design, energy insight, and energy cost savings. HOMER Energy by UL provides a strong foundation to empower people around the world with tools, services, and information to accelerate the adoption of renewable and distributed energy sources.



Try HOMER Pro for free at homerenergy.com/trypro or contact sales@homerenergy.com to learn more.

Empowering Trust®

Schneider Electric EcoStruxure Microgrid Operation Controls



Tap into your prosumer potential

The energy market is undergoing some profound changes. Tomorrow's energy system will be one in which growing numbers of consumers produce and store their own energy.
This heralds a significant shift in how energy will be generated, distributed and consumed. It also dramatically changes the relationship between utilities and their customers who will want to monetise their generation capability and their flexibility.

This new energy landscape can be seen already, with:

- Falling costs of photovoltaic and storage systems, making their electricity competitive with grids
- Changes in regulatory framework that endavour local generation and use of renewable energy
- Higher expected prices for traditional energy from the grid

This will inevitably impact your business by changing the energy purchasing profile of customers but also opening the door to new services and offers. As an energy supplier you can build on your knowledge of your customers to enrich the relationship with new services around local generation and microgrid.

57%

of consumers would consider investing in becoming power self-sufficient

(Source: Accenture)

Get ready for energy market challenges

Taking full advantage of prosumers' distributed energy resources is a major challenge for energy professionals. Schneider Electric microgrid solutions let you integrate demand-side distributed energy resources into a greener, more efficient and reliable energy system.

Leverage demand-side distributed energy resources to balance supply and demand:

- Building systems (HVAC, lighting, electric vehicles, hot water, etc.)
- Machines and industrial processes
- Energy storage systems
- Dispatchable energy sources (CHP, genset)
- Locally-generated renewable energy (solar, wind)

Boost end users' capacity to:

- Generate electricity
- Store energy
- Tailor their energy usage habits to their changing needs
- Make smart energy decisions

Innovate with Schneider Electric

Schneider Electric works side-by-side with the professionals shaping tomorrow's energy ecosystem. Schneider Electric offers an innovative microgrid-as-a-service solution that lets you:

- Tap into prosumers' energy flexibility in a fast, reliable way
- Aggregate the capacity of several prosumers
- Package capabilities as an attractive offer to grid users
- Interface efficiently with prosumers

Prosumer
Proactive energy producer and consumer.

DER
Distributed energy resources: energy consuming, generating, or storing devices present at end users' premises; distributed generation (wind, solar, CHP); energy storage (electric, thermal); dispatchable loads (heating and cooling systems, electric vehicle charging infrastructures, etc.).

Microgrid
An integrated energy system with interconnected loads and generation assets, operating in parallel with the grid or in an islanded mode.

DER dispatch
Dispatch and control of all generation and storage assets to balance loads

Demand response
Control demand in real time to balance supply

Island mode
Reset all operational settings for stable operation while disconnected

Volt/VAR control
Control local devices to maintain voltages within operating limits

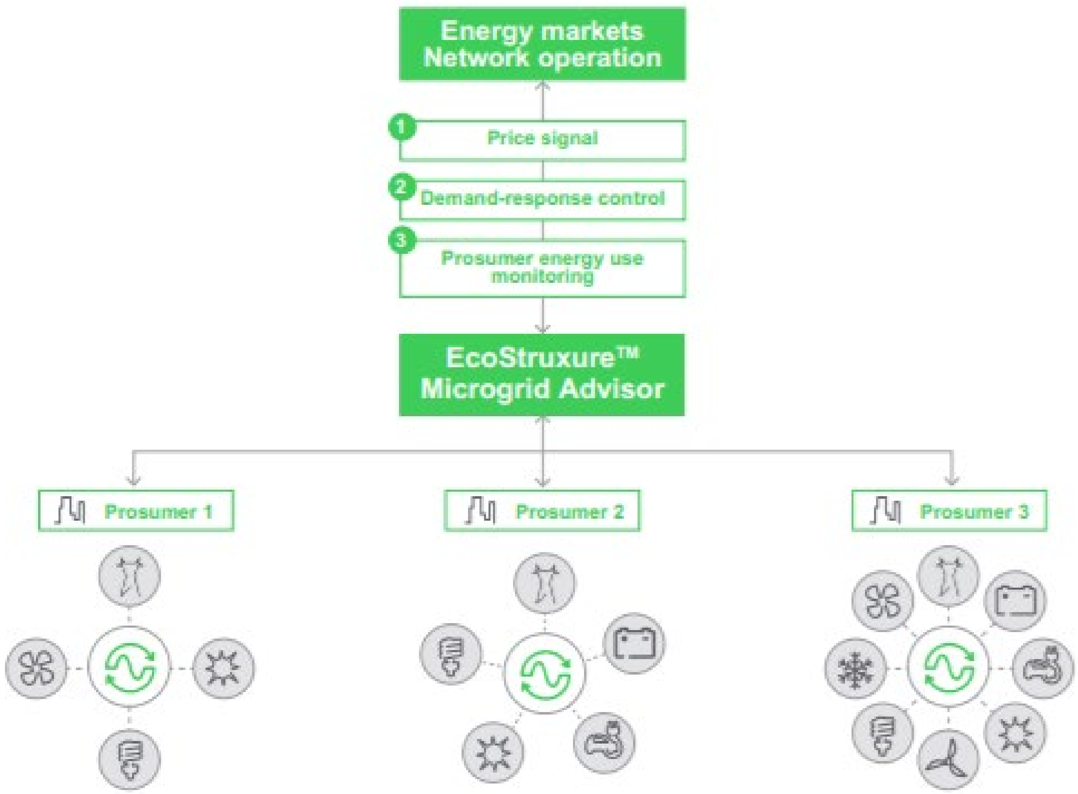
Up to 2 hours

of thermal inertia usable for load shifting when managing HVAC systems in buildings - without impacting comfort of occupants.

(Source: Schneider Electric, Greenlys)

Optimize for a smarter grid

The upcoming energy system is decentralized and interconnected, with two-way flows of data and energy. Digital technology also eases a local supply-demand optimisation with involvement of users.



Benefits

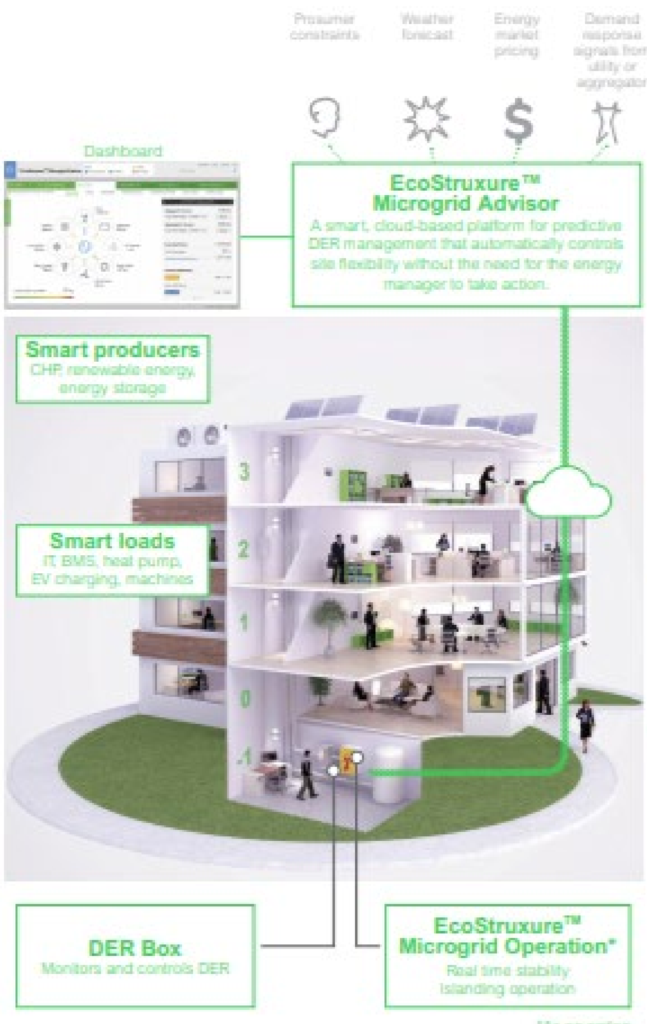
- Holistic energy management
- No additional investment in infrastructure needed to cope with peak load
- Increased resilience of prosumers in case of blackouts
- Better integration of renewables into the grid
- Ability to use prosumer DER to boost grid reliability
- Low-cost access to flexibility for a more balanced grid

Why utilities should care about microgrids

- Consumers can unlock and monetise their flexibility potential with their existing assets, such as industrial processes, heating, ventilation, or cooling, and on-site energy sources
- Retailers can offer new services to their customers, such as dynamic price plans, to improve their satisfaction and loyalty
- DSOs/TSOs can provide flexible capacity for its operating reserve to avoid imbalance and congestion issues, and to smoothly integrate variable renewable generation
- Suppliers can avoid investing in peaker plants that operate just a few hours a year with these alternative source of power
- Generators can swap stand-by reserve with demand response, and sell the freed up output capacity

Profit from comprehensive microgrid management

Our microgrid solutions extend the smart grid to within end users' premises. As a leader in smart grid technologies, you can trust that Schneider Electric will deliver a complete solution that is tailored to the needs of your customers, and ensures that they will know exactly when and how to store, self-consume, sell back energy, or participate to ancillary services.



Savings and energy control benefits

Two layers of energy management:

- Predictive with EcoStruxure™ Microgrid Advisor
- Reactive (real-time) with the EcoStruxure™ Microgrid Operation (optional)

Monitoring, forecasting and managing flexible resources

- Flexible loads such HVAC or thermal processes (using thermal inertia)
- Smart charging of electrical vehicles
- Electrical storage systems
- Dispatchable generation (CHP, gensets, etc.)

Monitoring and forecasting of other resources

- Variable renewable generation (PV, wind)
- Non flexible loads

Energy storage addresses the challenges of a rapid switchover to an alternative power source when a power disturbance occurs, and the stable delivery of power to the load until the disturbance is resolved.

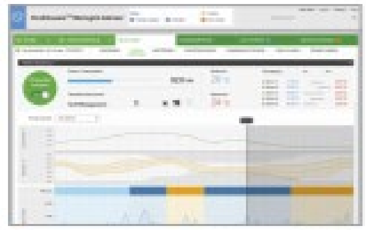
The components of our solution

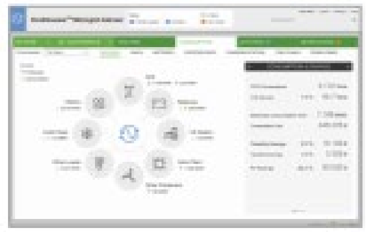
EcoStruxure™ Microgrid Advisor

An advanced Software as a Service and seamless interface optimizes your facilities energy performance

Features:

- Autonomous operation of end-user's DER – 24/7/365
- DER optimization across evolving use cases: tariff management, demand charge optimization, demand response, self consumption, islanding
- Proprietary predictive algorithms using weather forecast information, historical DER energy data, real-time electricity tariff rates, site specific operating constraints, etc.
- Operating schedules of all involved DER updated every 15 minutes
- 72 hours ahead and automatic default operation mode schedules guarantee
- User interface for PC, tablet, or smart Schneider or white label
- Native OpenADR to exchange information with third party utility platform and custom (Custom Web Services can be developed on demand)





DER Box

Enabling hardware for EcoStruxure™ Microgrid Advisor

Features:

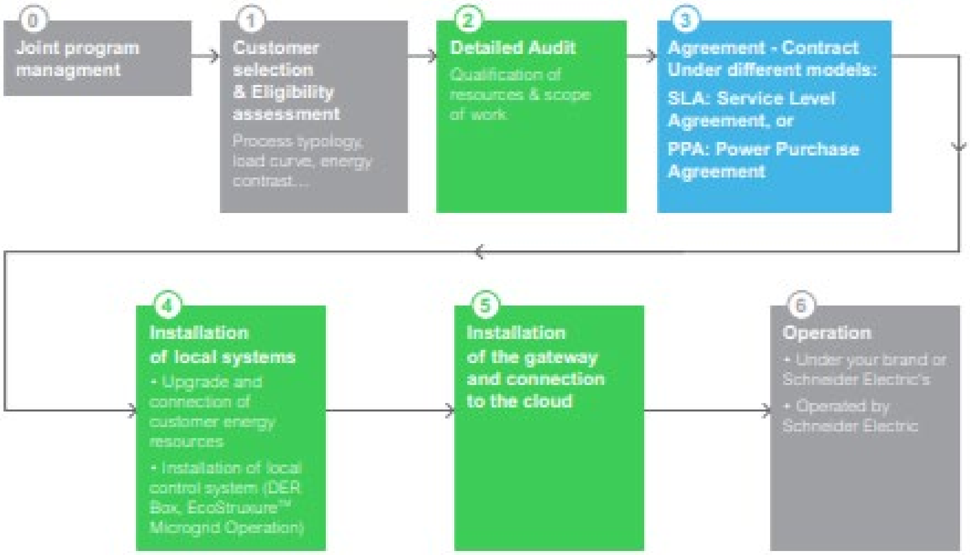
- Easy to install wall mounted cabinet, standard power supply and network connectivity
- Compatible with most DER – production sources (Solar PV, CHP, etc.), controllable loads (HVAC, EV charging stations, etc.), and energy storage systems
- Control and/or monitor your DER directly or through existing systems (e.g.: BMS)
- IT friendly – multiple connectivity options (3G/4G, proxy, ASSM)
- On device storage: for up to 7 days DER's and 3 days of DER's schedule
- Fully compatible with Schneider Electric EcoStruxure™ Microgrid Operation (islanding capability, real-time DER management)

Optional components

EcoStruxure™ Microgrid Operation – mandatory in case of islanding requirements

- Manage reconfiguration of electrical network under different conditions, including load shedding management
- Ensure real-time microgrid stability, including load sharing logic
- Open Ethernet I/O architecture
- Dual ports and redundancy for high reliability operation
- Microgrid software applications built on standard reliable platform

Craft your win-win partnership!



Possible operational model with utility partner

- Energy supplier and Schneider Electric
- Schneider Electric and/or qualified partner
- Energy supplier

Deploying our Microgrid-as-a-service solution

1. We work with you to set the project objectives, the implementation, and the end users to target.
2. We meet with end users to assess feasibility and potential of their sites.
3. We (or a certified Schneider Electric dealer) install the system and get it up and running.
4. The end user enters into a service agreement with energy supplier to use the platform.
5. The platform runs 24/7, optimizing the usage of different loads, distributed energy resources, and supply from utilities and other energy traders.

Benefits for all stakeholders

Our open solutions allow:

- Smart utilities to develop innovative business models (PPA, lease, EPC, etc.)
- End-user to grab benefits of new energies: reduce energy costs, reduce dependency from the grid, be greener
- System operators to leverage demand-side flexibilty on an fast, easy and cost-effective way

Take advantage of Schneider Electric's proven experience

- Hands-on knowledge of your customers' business-specific energy needs that positions us to accurately predict their consumption
- Expert know-how in electrical distribution systems from design to operation
- Targeted energy-market experience in areas like compensation and aggregation, ensuring that end users' energy resources are used most efficiently

Life Is On | Schneider Electric

schneider-electric.com/microgrids

Schneider Electric Industries SAS
Head Office
35, rue Joseph Monier
F-92505 Rueil-Malmaison Cedex
Phone: + 33 (0) 1 41 29 70 00
Fax: + 33 (0) 1 41 29 71 00

Document Number NRJED116736EN

Siemens RTU SICAM Microgrid Controls

Seamless operation. Maximum security.

Benefits at a glance

Maximum efficiency through a high-performing power supply system

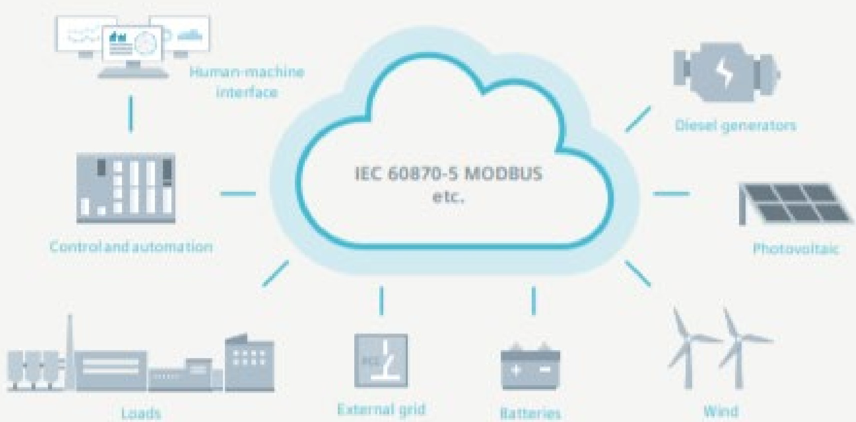
Excellent grid quality meets the stringent requirements of autonomous grid operation

Cost-effective operation with access to straightforward optimization capabilities

Comprehensive integration of renewable energy meets the climate protection targets that promote CO_2 reduction

Resource-efficient use protects the environment and minimizes costs

Microgrid Control – Configuration



Seamless operation. Maximum security.

Benefits at a glance

Maximum efficiency through a high-performing power supply system

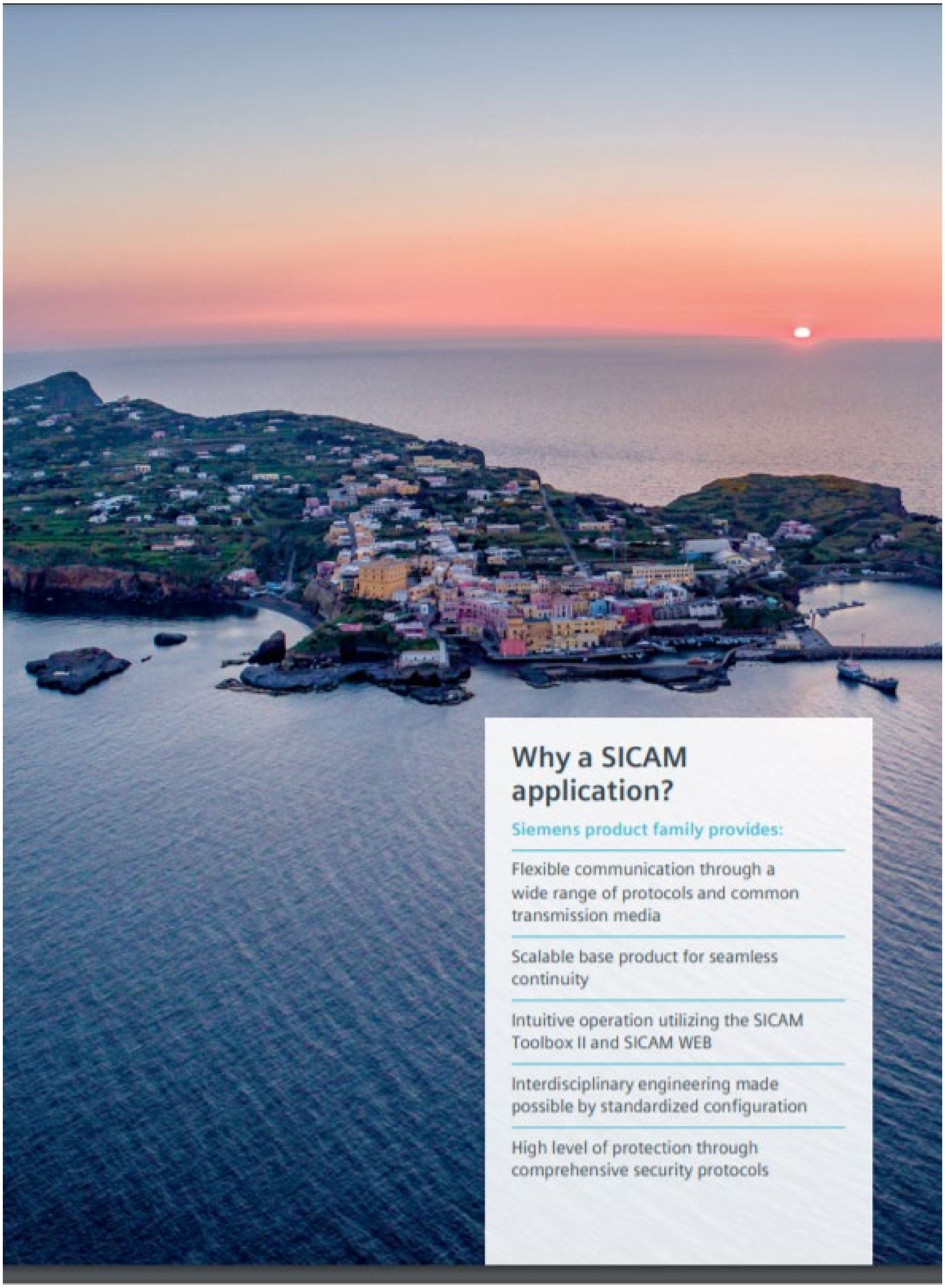
Excellent grid quality meets the stringent requirements of autonomous grid operation

Cost-effective operation with access to straightforward optimization capabilities

Comprehensive integration of renewable energy meets the climate protection targets that promote CO_2 reduction

Resource-efficient use protects the environment and minimizes costs

Microgrid Control – Configuration



Why a SICAM application?

Siemens product family provides:

Flexible communication through a wide range of protocols and common transmission media

Scalable base product for seamless continuity

Intuitive operation utilizing the SICAM Toolbox II and SICAM WEB

Interdisciplinary engineering made possible by standardized configuration

High level of protection through comprehensive security protocols

A solution to fit all your needs

The microgrid cabinet uses the compact, flexible, and powerful SICAM A8000 telecontrol and automation system.

Microgrid Control – a SICAM application: Smart migration, seamless integration

Intelligent energy management in a compact space, Microgrid Control can be seamlessly integrated into existing control systems. Earn points through the solid interplay between automation and remote control. Thanks to open interfaces and international standards, the solution supports unlimited migration. Perform maintenance through intuitive plug-and-play functionality.

Software-hardware combinations

Choose from one of two software-hardware combinations:

1. Gain more flexibility with an individualized configuration of standardized hardware and software blocks.
2. Benefit from a flexible control solution for microgrid automation with a cost-effective preconfigured microgrid cabinet. Its small, rugged housing design is optimal for new and retrofit installations.

Gain the reliability you need and the security you can count on. Discover Siemens' Microgrid Control – a SICAM application.

siemens.com/microgridcontroller

Published by
Siemens AG 2018

Energy Management Division
Freyeslebenstrasse 1
91058 Erlangen, Germany

For more information, please contact
our Customer Support Center.
Phone: +49 180 524 70 00
Fax: +49 180 524 24 71
(Charges depending on provider)
E-mail: support.energy@siemens.com

Article-No. EMDG-B90073-00-7600
Printed in Germany
Dispo 06200
HL 18023571 BR 0818

Hitachi e-mesh Microgrid Controls

HITACHI ABB

Efficient and performing
e-mesh Control

Unlocking potential across traditional and renewable energy assets

- Seamless transition between grid-connected and islanded modes.
- Maximize utilization of renewable energy
- Intelligent and efficient power management

HITACHI ABB POWER GRIDS

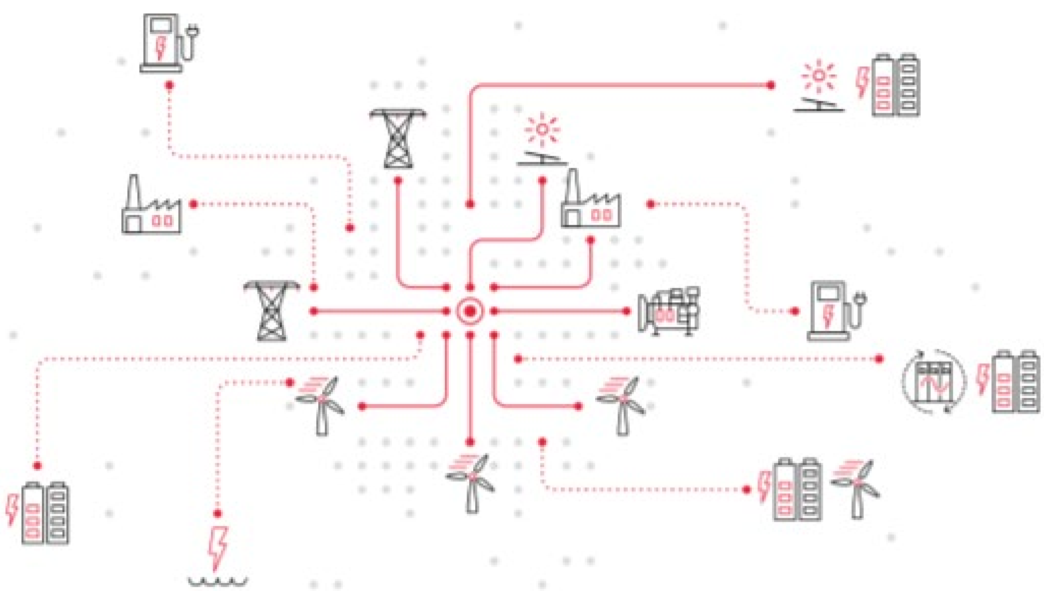
e-mesh Control for BESS, distributed and renewable energy resources

Ensuring a reliable and economical power supply with reduced carbon footprint

The rise of distributed energy resources means power generation companies must monitor, analyze and control a sophisticated set of generating assets whilst trying to minimize operational costs, increase operational availability and maximize revenue opportunities.

The e-mesh™ portfolio is a scalable, vertically integrated digital ecosystem to manage and optimize energy at all levels. It offers a wide range of applications from the field to the boardroom, both in the cloud and on premises.

e-mesh Control is based on Hitachi ABB Power Grids' robust, modular and scalable RTU platform. It is purposely designed for utility scale, microgrid and distributed energy resources solutions with application-specific libraries that minimize engineering effort.



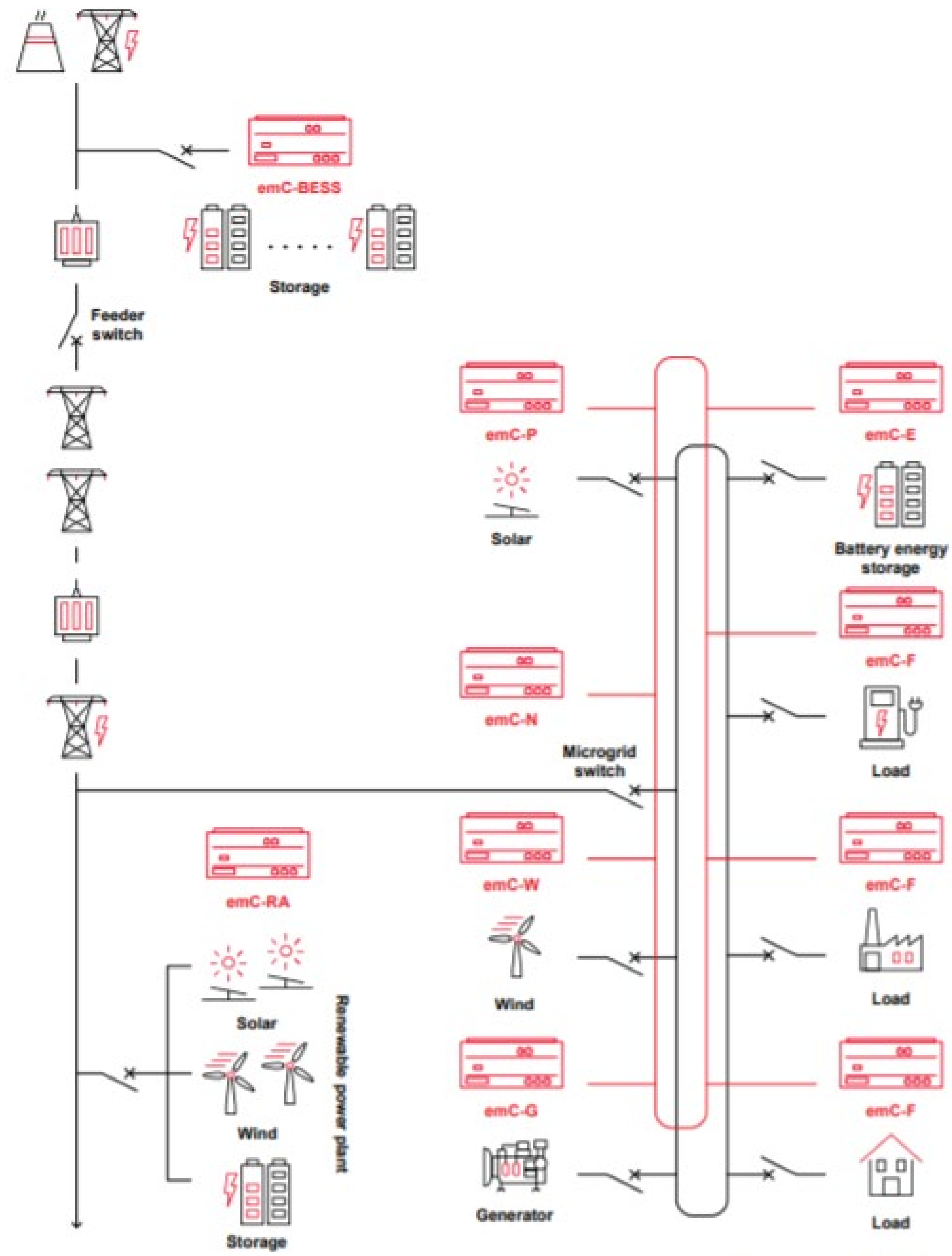
Key features

- Compliance with utility scale facilities grid code requirements ensuring high-quality power availability
- Effective and efficient integration of multiple energy resources
- Extensive set of advanced power system functionalities, both grid connected and islanded
- Strong and resilient cybersecurity features
- Augmented resiliency ensuring power to critical loads during outages
- Applicable in both green field and brown field scenarios
- Intuitive and flexible configuration both on premises and remotely
- Easily scalable and upgradeable to safeguard your investments
- Vertically integrated with the other products in the e-mesh portfolio.
- Enhanced operations and maintenance of all connected energy assets

Key benefits

- Address site automation and control with a unique solution
- Maximizes renewables utilization to reduce carbon footprint
- Reduces cost of energy and operation by coordinating utility scale and distributed energy resources
- Protects the environment by improving traditional and distributed energy assets efficiency

Integrate different energy assets through the power system from generation to consumption ...



... and across applications

Use case	Energy Assets	Controller	Application	Features
Utility Scale		emC-BESS	Battery energy storage systems power plant control	• F/P & U/Q/PF control, seamless transitions • Grid support mode (frequency and voltage droop support) • Grid Synchronization • Planned islanding • Direct active power set points • Overload intermittency support • Peak shaving
		emC-RA	Renewable (PV, wind) power plant control	• Active power curtailment with gridcode compliant ramp rate limiter • Frequency support • PV active / reactive power sharing • Renewable smoothing • Reactive power regulation • Capacitor bank management • Battery energy storage automatic recharge
Microgrid		emC-P	PV inverters	• Smoothing • Renewable curtailment • Step load requirements • P & Q sharing, etc.
		emC-E	Battery energy storage systems	• SoC management • F/P & U/Q control, P & Q sharing • Grid support mode • Direct active power set points • Overload intermittency support • Step load & spinning reserve • Peak shaving/shifting, seamless transition
		emC-G	Fossil fuel generators	• Ideal loading of power set points • Step load requirements • Spinning reserve • P & Q sharing • Remote voltage control, etc.
		emC-W	Wind turbines	• Smoothing • Renewable curtailment • Step load requirements • P & Q sharing, etc.
		emC-F	Load feeders	• Peak shaving/shifting • Load scheduling • Seamless transition
		emC-N	Grid/network interface	• Grid synchronization • Planned islanding, seamless transition • Q/U/PF control • Peak shaving/shifting

Grid edge technology
e-mesh Control uses grid edge technology to stay ahead of the curve by using Industrial Internet of Things technology.

Grid code compliant
Complies to international grid codes and standards, to ensure plant stability.

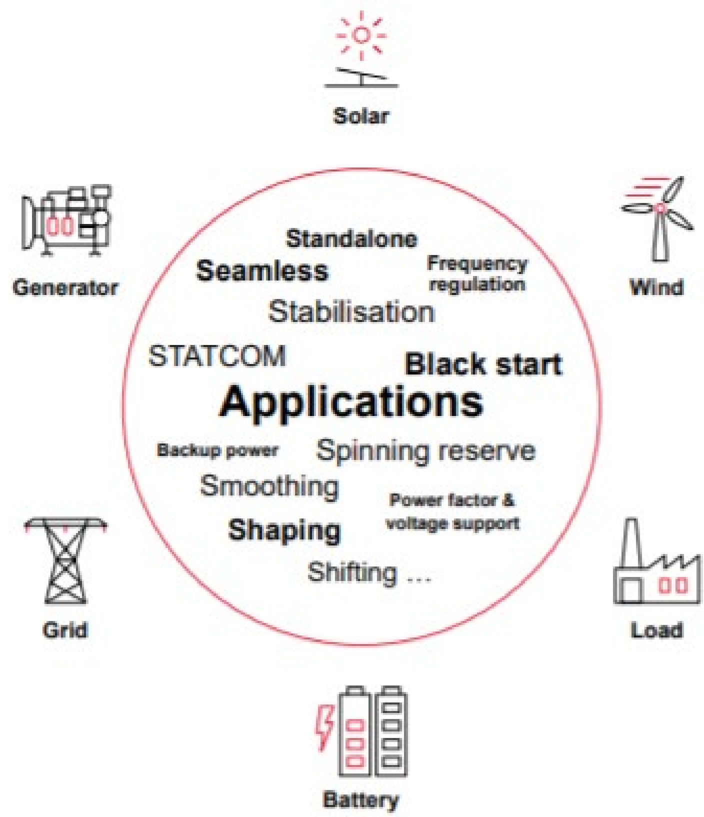
Connectivity
Supports various industrial open protocols like IEC60870-104, Modbus and DNP3.

Cyber security
Includes technical features that help utilities or other end users become NERC-CIP or local cyber security regulations compliant.

Simplified solution
Our controllers are based on a common hardware platform, reducing costs and minimising spare parts handling.

Easy to handle
Delivered ready-to-use, pre-configured and type-tested for different applications. Hardware is flexible and easy to scale up.

e-mesh Control
Intelligent and efficient power management



Global service support
Backed by 125 years of technology leadership, domain expertise and the industry's largest installed base, Hitachi ABB Power Grids helps customers optimize asset performance.

Our after-sales support and global services team enables companies to reduce maintenance spend whilst better protecting assets and employees. Lifecycle management and training can also be provided.

HITACHI ABB

Hitachi ABB Power Grids
Brown-Boveri Strasse 5
8050 Zurich
Switzerland

hitachiabb-powergrids.com